
IV. *A new Method for compoſing a natural Hiſtory of* Meteors *communicated in a Letter to Dr.* Jurin, R. S. & Coll. Med. Lond. Soc. *By Mr.* Iſaac Greenwood, *Profeſſor of Mathematicks at* Cambridge, New-England.

Honoured Sir,

THIS Method in general is, that in Addition to ſuch Obſervations as ſhould be made on Land, there might be ſome Account taken of thoſe alſo that were made at Sea; which already are by far more numerous than what were ever made aſhore, or indeed what can be expected thence for ſome Ages ſtill to come. This Method occured to me, as I was looking over various *Journals of Voyages* in my Paſſage from *England*, in which I was not a little ſurpriz'd to find the following Particulars conſtantly obſerv'd.

Firſt, There was a general Account of the *Weather* for every Day, during the Paſſage of the Ship on the Voyage, which tho' not quite ſo exact as the Obſervations of the ſame Kind that have been made on Land, particularly what were publiſh'd by the Rev. Mr. *Derham*, yet for all that I know, are ſufficient for the Deſign. However, if there is any Defect in this Article, it is abundantly made up in another Column; which is a far more exact Regiſter of the *Direction of the Winds* than was ever kept *aſhore*, being an Account thereof to every two Hours in the Day. This Article may perhaps be of very great Importance; ſince, as you obſerve, *Compertum habemus, ut quod maximè, ſubitas tempeſtatum commutationes* Ventis *præcipuè acceptas eſſe referendas*. As for the *Degree* or *Strength* of the Wind there are alſo ſufficient *Data* in all Sea-Journals to determine it, as I ſhall particularly ſhew in the Sequel of this Letter: Laſtly, there is a daily Account inſerted of the *Latitude* and *Longitude* of the Ship, that there will be no Difficulty in computing what Part of the Globe each Obſervation belongs to.

And now ſince there is in the World a great Variety of theſe *Marine Obſervations* already made, (for in all Voyages whatſoever that have been perform'd for many Years paſt, it has been cuſtomary to keep an exact Journal of the aforeſaid Articles,) I thought it might be no difficult Matter to collect therefrom the *Hiſtory* of the *Winds*, and *Weather* in moſt Parts of the Ocean.

In order to this, I imagin'd that if the *Royal Societies* of *London* and *Paris* ſhould encourage ſuch a Deſign, they might eaſily procure *Extracts* from moſt of the Journals kept in their reſpective *Nations*: For certainly ſuch Gentlemen as would be at the Pains to keep a conſtant *Diary* of the Weather, would not fail alſo to communicate ſuch *Marine Obſervations*, as they ſhould be able to obtain.

The *Seamen* likewiſe themſelves, (among whom there are a conſiderable Number of ſuch as have a Taſte for *phyſical* Knowledge) as they are under a Kind of Neceſſity to obſerve exactly the *Winds*, &c. would not be backward in tranſmitting their Obſervations; eſpecially when they were informed of what Importance and Advantage it might be to themſelves, and the Cauſe of *Navigation*.

I proceeded further to think, that if the aforeſaid *Societies* ſhould judge it improper to be at ſo great an Expence as would be requiſite in printing ſo many Extracts from ſuch Journals as ſhould be ſent to them, that they might notwithſtanding keep in *Manuſcript* a Book of Tables of ſuch *Marine Obſervations*, as they ſhould think fit to collect therefrom; and that the *Secretaries* of the Society (who for the moſt Part are ſuch Gentlemen as have in a particular Manner diſcover'd a generous Principle of promoting Natural Knowledge) ſhould take Care, that all ſuch Obſervations were tranſcribed in their proper Places.

The Form of theſe *Tables* I thought might be in the following Manner.

January the First, 1726.										
Longitude.		20.			21.			22.		
Latitude	H.	W.	D.	Weather.	W.	D.	Weather.	W.	D.	Weather.
30.	12.	N.	2.	Fair.						
	6.									
	12.	N b E	3.	Fair.						
	6.									
31.	12.							S b E	2.	Cloudy.
	6.								2.	Rain.
	12.							S	3.	Stm. of Rain.
	6.							S b E	2.	Rain.

In which the *Title* ſhews the *Year*, *Month*, and *Day*; the *horizontal Space* juſt below it, the *Longitudes*; the *vertical Space* without the double Lines, the *Latitudes*; *that within the double Lines*, the *Hour* of the Day; and the *horizontal ſpaces* under the Longitudes,

tudes, the *Wind*, its *Degree*, or ***Strength***, and the *Weather*, which are accordingly mark'd with W. D. Weather.

In this Specimen I have noted every Degree of Latitude and Longitude, that the Work might be the more perfect. I have only taken Notice of Four Hours in the Day, *viz.* 12 at Noon, 6 in the Afternoon, 12 at Night, and 6 in the Morning. However, if there be requir'd a greater Exactneſs in this Article, it will be eaſy enough to frame Tables accordingly. I began the Hours with 12 at Noon, becauſe all Journals are kept from that Period, the Marine Day being always counted from Noon to Noon. There may be other Columns inſerted, as I ſhall mention in the Cloſe of this Letter, tho' what I have already taken Notice of is ſufficient to our preſent Deſign.

Of theſe Sort of Tables there muſt be at leaſt Four Volumes; One for the *Atlantick Ocean*, which will be by far the largeſt of them all, and perhaps the moſt profitable, as moſt of the Trade of the World lies thereon; the ſecond for the *Mediterranean*; and the others for the *German Sea* and *Baltick.* In Proceſs of Time alſo, it may perhaps be thought worth the while to preſerve ſuch Obſervations as are made on the *Indian Sea*, and the *Pacific Ocean.*

I muſt acknowledge my ſelf incapable of making a juſt Compariſon between the Advantages and Inconveniencies attending ſuch a *tabular Regiſter* of the Winds and Weather, as I have propoſed; however, I will take the Liberty to mention one or two Things, by which you will ſee how the Matter appears unto me.

It muſt be confeſs'd, that the Work will be very much protracted, and require ſome conſiderable Application and Care in extracting ſuch Obſervations, as ſhall be of Uſe, from Journals. There will alſo be ſome Difficulty in procuring any conſiderable Number of ſuch Journals; and laſtly, there is but a very ſmall Number of Obſervations made, in Compariſon to the Spaces that muſt be allow'd in the Tables for them, by which Means there muſt neceſſarily be a great Waſte.

In Anſwer to theſe Objections, it may be ſaid in general, that there will be much leſs Application and Care requir'd than in keeping a *Diary* of the Weather, &c. on the *Land.* By this Means alſo, there may be more Obſervations collected in a few Years, than can be expected from the other Method in ſome Ages; and one Man may be able in a few Months, hereby to compile a larger Hiſtory of the Weather, than what has hitherto been done by the united Obſervation of all ſuch, as have undertaken this Province.

Tho' there might be ſome Difficulty as to *particular Perſons* in procuring a great Number of Journals, it cannot be ſuppos'd, that ſo illuſtrious a Body of Men as the *Royal Societies* at *London* and *Paris*, ſhould meet with the ſame. It is obſervable alſo, that in the *Royal Navy* of *Great-Britain*, the Maſters of the *Mathematicks* are oblig'd to keep ſuch a Journal by an Act in the late Reign, on Board every Ship, which without Doubt might be eaſily obtained on this Occaſion: Nor can we imagine any in the trading Intereſt would refuſe a Thing, that tended ſo much to their own Advantage and Benefit.

It is true, there can be no Remedy for the many empty Spaces in the Tables, (if that Method be follow'd which I have propos'd;) however this will be look'd upon as a trifling Objection, by ſuch as conſult the Improvement of *Natural Knowledge*, rather than the Waſte of Paper.

I ſhall conclude theſe general Remarks, by obſerving, that as the Hiſtory of the Winds and Weather is capable of a more ſpeedy and expeditious Improvement from *Marine Obſervations* than from Diaries from the *Land*, ſo alſo it is capable hereby of a more large and extenſive Improvement. Without Doubt it will require many Years before *Obſervatories* of the Weather, *&c.* will be erected at all the *Univerſities* and *Capital Towns* of the *Provinces*, *Shires*, &c. in *Europe*, (if ever ſuch ſhould be,) not to mention *Africa*, *Aſia*, and *America*, from which little can be expected in this Affair; and yet upon that Suppoſition, how few would the Diaries be, in Compariſon of the great Number of Journals that are annually kept at *Sea?* beſides many Thouſands that might perhaps be obtain'd, relating to the Courſe of the Winds and Weather, ſucceſſively for many Years laſt paſt. It is beyond my Abilities, indeed, to calculate with any Exactneſs, how many Veſſels there may be upon the Seas which I have named, in the Space of one Year, and conſequently how many diſtinct Journals there are annually kept; however, if I may judge from the Trade of the little Town, where this Letter is dated, there muſt be many Thouſands: For there are ſeldom leſs than eight or nine Hundred Voyages made to and from this Port in a Year. I ſhall only add in this Place, that the Method here propos'd ſeems to have the Advantage of the common Method heretofore uſed in compoſing the *Natural Hiſtory of Meteors*; inaſmuch as *that* requires a particular Application and Attention without any other Views and Advantages; whereas in *our Caſe* there is a Kind of Neceſſity of making ſuch Obſervations, in order to conduct a Ship ſafely thro' the Ocean, whether the philoſophical Part of Mankind ſhall think fit to improve them in their Intereſt, or no: However, I would not be underſtood, by any Thing that has been ſaid upon this Head, to derogate from the Deſign of obſerving *on Land*, for that likewiſe has many Advantages, that we can by no Means pretend to in the *New Method.*

I ſhould protract my Letter to an unreaſonable Length, did I enter profeſſedly upon the particular Advantages and Benefits, that may accrue from ſuch a *Tabular Regiſter* of *Marine Obſervations*, as I have propoſed. I ſhall mention therefore only two Things.

Firſt, We may be able from this Method to define with a great deal of Exactneſs, the Bounds and Limits of all conſiderable Winds; for as there are at all Times in the Year ſome Hundreds of Veſſels at Sea, it is of the ſame Importance in our Caſe, as tho' there were ſo many diſtant Obſervatories there; and that the Knowledge of theſe more *extenſive* and *general Winds* would be of conſiderable Uſe, none will deny, that ſhall attentively conſider it; for hereby we may be able to judge, in what Place ſuch a Wind has its Origin, how long a Time it continues, with what Velocity it moves, where its greateſt Strength is, and how great a Part of the Earth it paſſes over. Perhaps alſo, in Proceſs of Time, by this Means, we may arrive to ſo much Skill, as to judge with ſome conſiderable Certainty, from the Riſe or Beginning of a Wind, what its Effect and Iſſue ſhall be; which will be of as great Importance in *Navigation*, as any Thing ſtill wanting. Again, from ſuch *Marine Obſervations* of the more extenſive and laſting Winds, it is not impoſſible, that we ſhould be able to make a probable Judgment of the Effect and Influence of the Wind upon the Weather; which, for what Cauſe I know not, I have frequently obſerved at Sea, to change and alter, according as that doth.

Secondly, From collecting all ſuch *Meteorological Obſervations* as are made at *Sea*, we may reaſonably expect to come to the Knowledge of ſuch Winds, as prevail moſt in particular *Latitudes*. Tho' the Wind is a very uncertain Meteor, there is no Doubt, but that in ſome Places, it has a very different Courſe from what it has in others. If I miſtake not alſo, it has been frequently obſerved, in ſome particular Places, that the Courſe of the Wind in one Year has been much the ſame as in others; and tho' there has been no particular Order or Exactneſs yet diſcover'd, yet the *prevalent Winds*, or the greater Number of Winds have been, in both Caſes, according to the ſame Direction: In theſe Parts of the World it is remarkably ſo. We can't, indeed, expect to diſcover the *Reigning* or *Prevalent Winds* of ſuch *Latitudes*, as are very diſtant from the *Tropicks*, by as eaſy an Obſervation, as the *Trade-Winds* and *Monſoons*, which are in the *Torrid Zone*, were firſt found out. However as it has been after many Obſervations, that the Courſe of thoſe *Fix'd Winds* was determin'd, we may alſo hope, that Time and Induſtry may bring us to a much better Knowledge than what we have at preſent, of theſe which are more *Variable*. I need not ſay of how much Importance it would be to the Trading Part of the World, were we able to define the more frequent and reigning Winds of every Climate; for as the Probability of Voyages might then be calculated in the ſame Manner as that of other Chances, the Sailor might then better know how to order his Courſe ſo, as to arrive with the moſt probable Diſpatch to his Port.

It may not be impoſſible alſo, from a protracted Series of *Sea Obſervations*, not only to know the general Courſe of the Winds in every Climate in the whole Year, but alſo to make a very probable Judgment of the reigning Winds of the ſeveral *Seaſons of the Year*, and perhaps of *every Month* too: Which if it could once be obtained, we ſhould have nothing more uncertain in *Navigation*, than that it was a *Doctrine of Chances*, which might be mathematically calculated.

I ſhall mention under this Head but one thing more, which we may with all the Probability imaginable expect to arrive to, *viz.* the particular Seaſons, Signs, and Places of the *Tornados* and *Hurricanes*. The Effect of theſe are in many Caſes ſo fatal, that they call for all our Skill and Obſervation: And could the Hiſtory hereof be ſo ſucceſſively known, as that we might be able to draw any certain Concluſions from it relating hereunto, it might perhaps be a ſufficient Recompence for all the Care, that is requir'd, in the whole Collection of *Marine Obſervations*.

I might add in common to the two foregoing Heads, that the *Marine Obſervations* have much the Advantage of ſuch as are made *on Land*, (which notwithſtanding are of very great Service,) inaſmuch as they are not obnoxious to any external Accidents, as theſe are; the Winds aſhore being frequently interrupted in their Courſe, and often diverted therefrom, by intervening Mountains, Vallies or Promontories.

Were I allowed to reckon among the Advantages of this *New Method* of obſerving on the Winds and Weather, thoſe incidental Obſervations, that might be found in *Journals*, of general Benefit to Mankind, they are perhaps alone ſufficient to engage us in the Work. I ſhall only hint here, that if it ſhould be thought proper to practice our Deſign, it may perhaps be worth the while to inſert into the *Meteorological Tables*, ſuch Obſervations as relate to the *Variation of the Compaſs* and *Currents* ; the true Knowledge of which would be of no inconſiderable Service to *Navigation.*

If likewiſe there was a Column left for ſuch remarkable Accidents as did occur, it might not be amiſs; particularly, any uncommon Diſcoveries of Lands, Rocks, or Soundings ; exceſſive Thunder and Lightning, *&c.* Luminous Appearances in the Sky; what Remarks may be found relating to the Water-Spout, which tho' perhaps one of the moſt curious Phænomena of Nature, is as little known as any whatſoever; ſubmarine *Hiatus* or Wirlpools, if any ſuch there be; and laſtly, any extraordinary Rendezvous of Fiſh, *&c.* that are uſed in the Affairs of Life, not to mention ſuch Deſcriptions, as may relate to Matters of meer Speculation and Curioſity.

But theſe Sort of accidental Advantages, in ſuch a Collection of Journals of Voyages, as is neceſſary to our Deſign, are too numerous to be inſiſted on : I ſhall therefore only add one more, which is the great Improvement there would hereby be given to *Geography*, a Science of the greateſt Uſe and Importance in the Affairs of Life. Not only all *Hydrographical Charts* might be by this Means corrected, and brought to the Truth, which is of ſo much Concern, that the Lives of a great Part of ſuch as go to Sea depend upon it ; but alſo, the Diſtances and Situation of all *Sea-Ports*, and many other Things, which are uncertain, or wanting in that Science, determin'd with the greateſt Exactneſs.

In a Word, *Geography* may, by ſuch an Expedient, arrive, in a very expeditious Manner, to as great a Degree of Perfection, as it is capable of.

I ſhall have finiſh'd my Deſign in this Letter, when I have taken Notice of the Method of determining the Degree and Strength of the Wind, from ſuch *Data* relating thereunto, as are to be found in Sea-Journals; which in general is, from obſerving how many *Knots* the Veſſel goes at the Time of Obſervation; which is always inſerted in the *Day-Book* or *Journal*; or, in other Words, what *Velocity* ſhe then has; for the Strength of the Wind may, with Exactneſs enough, in this Affair, be judg'd of from the Effect it produces, or the Motion it communicates to the Ship. It is true, there will be ſome conſiderable Difference in this Reſpect, ariſing from the Shape and Burthen of the Veſſel: However, as we do not expect a mathematical Exactneſs in this Article, after a little Uſe and Experience, together with comparing the greateſt Velocities of different Ships together, a Perſon may ſeldom fail of judging of the Strength of the Wind, at leaſt to a fourth Part; that is, if according to the Method you propoſe in your *Invitatio ad Obſervationes Meteorologicas*, the greateſt Winds be expreſs'd by 4, and the lighteſt by *Unity*.

In *Oblique Winds*, the Strength or Degree thereof will not be directly proportional to the Velocity of the Veſſel, but muſt be corrected a little; however, there will be no Difficulty in this Matter. For ſuch as are acquainted with the Method of reſolving *Oblique Powers* into *Direct ones*, may eaſily compoſe a Table of *Proportional Parts* ſuited thereunto. I did intend to have inſerted ſuch a Table; but I am afraid I have already treſpaſs'd in the Length of this Epiſtle, and ſhall therefore only add, at preſent, that I am,

With the utmoſt Sincerity and Reſpect,

Your moſt obedient, and

devoted humble Servant,

Iſaac Greenwood.

POSTSCRIPT.

SINCE my writing the foregoing, I have thought on a *Method* of keeping the *Meteorological Tables* therein propoſed, whereby the Work will be very much contracted. This is, inſtead of conſtructing the *Tables* according to the *Oceans* whereon the moſt conſiderable Trade of the World lies, to frame them only according to the *Route* of the moſt common *Voyages* on thoſe *Seas*. Thus, may one of the *Tables* be confin'd to that Part of the *Atlantick Ocean*, which ſuch Ships generally paſs over, that Trade between *Great-Britain* and the *Weſt Indies*; another *Table* for thoſe Parts of the *Ocean*, that lie in the Paſſage of ſuch Ships as are engaged in the *Mediterranean*, or *Turkey Trade*; to which may be added a *Table* for the *African*, and *India Commerce*. Another *Table* may be framed to that Part of the *Ocean*, that lies between the *Northern Provinces* in *America* and the *Weſt Indies*; as alſo one for the Ships that paſs between *New-England*, and

New-York and *Britain*, which on the Northern Part may be made ſo wide as to take in the *Newfoundland* Trade, *&c.* But I ſhall mention no more Particulars; for in the ſame Manner it will be eaſy to conſtruct *Tables* to all thoſe conſiderable Parts of the World, to which Voyages are perform'd.

V. *Some Obſervations towards compoſing a Natural Hiſtory of* Mines *and* Metals, *communicated in a Letter to Dr.* Rutty, S. R. Secr. *&* Coll. Med. Lond. Soc. *By Dr.* Frank Nicholls, Profeſſor *of* Anatomy *at* Oxford.

Dear Sir,

IN Obedience to your Commands, I here ſend you the Particulars of what I obſerv'd during a Year's Stay in the Weſtern Part of *Cornwall*, concerning *Mines*, &c.

Mines in general are Veins or Cavities within the Earth, whoſe Sides receding from, or approaching nearer to each other, make them of unequal Breadths in different Places; ſometimes forming large Spaces, which are call'd Holes. They are fill'd with Subſtances, which, whether metallick, or of any other Nature, are term'd the *Loads*. When the Subſtances forming theſe Loads are reducible to Metal, the Loads are by the Miners ſaid to be *alive*; otherwiſe they are term'd *dead Loads*.